

# SELECTION OF CONTRACTOR USING ANALYTICAL HIERARCHY PROCESS (AHP)

NURUL SYAFIQAH BINTI ZAINI

B. ENG(HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG



## **SUPERVISOR'S DECLARATION**

I hereby declare I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the award of Bachelor of Civil Engineering.

---

(Supervisor's Signature)

Full Name :

Position :

Date :



## **STUDENT'S DECLARATION**

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

---

(Student's Signature)

Full Name : NURUL SYAFIQAH BINTI ZAINI

ID Number : AA14109

Date :

SELECTION OF CONTRACTOR USING ANALYTICAL HIERARCHY PROCESS  
(AHP)

NURUL SYAFIQAH BINTI ZAINI

Thesis submitted in fulfillment of the requirements  
for the award of the  
Bachelor Degree in Civil Engineering

Faculty of Civil Engineering and Earth Resources  
UNIVERSITI MALAYSIA PAHANG

JUNE 2018

## **ACKNOWLEDGEMENTS**

First of all, Alhamdulillah I am grateful because through patience, time and the knowledge that I have gain to complete my research. I also would like to take the chances to thanks my supervisor, Mr. Noram Irwan Bin Ramli for his valuable guidance, advises and his time throughout the entire research. Therefore, I was being able to complete my research on time.

I would like to express my appreciation and thanks to all my family members especially my parents for all their support throughout the work. I am also grateful to my friends for their valuable advice and opinion. A lot of thanks also to staff and people that involve in Universiti Malaysia Pahang (UMP) Campus Gambang for providing adequate facilities in supporting relevant literature.

My thanks also to people who have been involved in this research by helping me in my presentation through the research.

Moreover, thanks again to my family for being supportive and encouraging throughout my research. Thanks you very much.

## **ABSTRAK**

Projek-projek pembinaan sedang berjalan pesat di Malaysia dan telah menjadi salah satu faktor penting dalam menyumbang peningkatan ekonomi negara. Kerana itu, pemilihan kontraktor merupakan aspek penting dalam sektor pembinaan terutamanya bagi klien atau pihak yang melibatkan keperluan untuk mengupah kontraktor terbaik untuk mengurus dan menyelesaikan projek mereka dalam masa dan kos yang diberikan juga dengan kualiti yang baik. Selain itu, tanpa menggunakan kaedah yang sesuai dalam pemilihan kontraktor, ia pasti akan menjejaskan penyelesaian keseluruhan projek. Dalam kajian ini, saya melakukan penyelidikan mengenai penggunaan proses hierarki analisis (AHP) sebagai model sokongan keputusan untuk memilih kontraktor. AHP membolehkan keputusan membina sebagai hierarki dan setiap kriteria boleh dinilai dengan skala keutamaan (dari 1 hingga 9) yang ditentukan oleh pakar dalam bidang pembinaan. Tujuan kajian ini adalah untuk mengenal pasti kriteria utama yang digunakan oleh pelanggan dalam pemilihan kontraktor juga menentukan kriteria pemberat dengan menggunakan kaedah AHP dari amalan semasa di Malaysia. Selain itu, kaedah ini adalah salah satu kaedah yang perlu untuk mengurangkan risiko kegagalan projek disebabkan prestasi kontraktor yang lemah.

## **ABSTRACT**

Construction projects are now progressing rapidly in Malaysia and have been as one of an important factor in contributing increasing economic country. Because of that, contractor selection is an important aspect in construction sector especially for client or parties involve that need to hire the best contractor to manage and complete their project within time and cost given also with good quality. Furthermore, without a suitable method use in selection of contractor, it for sure will affect the completion of whole project. In this study, I am doing research about the use of the analytical hierarchy process (AHP) as a decision support model to select contractor. The AHP allows constructing decision as hierarchies and each criterion can be evaluated through weighted determined by the expert in construction field. The purpose of this study is to develop the main criteria used by client in selection of contractors also identify the weighted criteria by using AHP method from current practice in Malaysia. Besides, this method is one of the decision-making that is necessary to eliminate the risks of project failure due to poor contractor's performance.

## **TABLE OF CONTENT**

**DECLARATION**

**TITLE PAGE**

**ACKNOWLEDGEMENTS** **iii**

**ABSTRAK** **iv**

**ABSTRACT** **v**

**TABLE OF CONTENT** **vi**

**LIST OF TABLES** **ix**

**LIST OF FIGURES** **x**

**LIST OF SYMBOLS** **xi**

**CHAPTER 1 INTRODUCTION** **1**

1.1 Introduction 1

1.2 Problem Statement 3

1.3 Objective 4

1.4 Scope of Study 5

1.5 Significant of Study 6

1.6 Methodology 7

**CHAPTER 2 STYLES** **9**

2.1 Introduction 9

2.2 Contractor 10

2.2.1 Category of Contractor 12

2.3 Issue in Selection of Contractor 13



2.4	Qualified Contractor	14
2.4.1	Contractor registration requirement and proceduring with CIDB	15
2.4.2	Tender Evaluation Guideline (MOF)	16
2.4.3	Tender evaluation (stage)	19
2.5	Criteria of Contractor	21
2.6	Analytical Hierarchy Process (AHP)	23
2.4.3	Applying AHP method	24
2.4.3	Consistency Index & Consistency Ratio	25
2.6	Geometric Mean	27
<b>CHAPTER 3 METHODOLOGY</b>		<b>28</b>
3.1	Introduction	28
3.2	Decision Making	29
3.3	Consistency	30
3.4	Making Final Decision	31
3.5	Questionnaire	31
<b>CHAPTER 4 RESULTS AND DISCUSSION</b>		<b>34</b>
4.1	Introduction	34
4.2	Questionnaire Collection	34
4.3	Responses	36
4.4	Personal Particular	37
4.4.1	Designation	37
4.4.2	Type of Company	38
4.4.3	Duration Individual Experience	39
4.5	Level of knowledge	39

4.6	Weighted Criteria	40
4.6.1	Consistency Index & Consistency Ratio	41
4.6.2	Comparison Weighted	43
4.6.3	Geometric Mean	44
<b>CHAPTER 5 CONCLUSION AND RECOMMENDATION</b>		<b>45</b>
5.1	Introduction	45
5.2	Conclusion	45
5.2.1	Objective 1	46
5.2.2	Objective 2	46
5.3	Making a Final Decision	46
5.4	Summerize Responses	47
5.5	Recommendation	48
<b>REFERENCES</b>		<b>49</b>
<b>APPENDIX</b>		<b>54</b>
	Questionnaire (Google Doc)	54

## LIST OF TABLES

Table 2.1	Limit of building/civil/mechanical work cost (CIDB,2015a)	12
Table 2.2	Limit of building electrical work cost (CIDB,2015a)	13
Table 2.3	Contractor service center	17
Table 2.4	Construction Industry Development Board (CIDB)	18
Table 2.5	Financial Limit (CLASS)	19
Table 2.6	Scale Saaty's	25
Table 2.7	Random Consistency Index	26
Table 3.1	Random Consistent Index	30
Table 4.1	Number of Responses	35
Table 4.2	Weighted Criteria	40
Table 4.3	Random Consistent Index	42
Table 4.4	Result of Consistency	42
Table 4.5	Geometric Mean	44

## **LIST OF FIGURES**

Figure 1.1	Flow Chart of Methodology	8
Figure 2.1	Example evaluation of contractor (Government)	20
Figure 2.2	Example of criteria to select contractor	21
Figure 2.3	Geometric Mean Method	27
Figure 3.1	Framawork Structure	29
Figure 3.2	Flow chart of methodology	33
Figure 4.1	Percentage of Gender	35
Figure 4.2	Respondents Designation	37
Figure 4.3	Type of Company	38
Figure 4.4	Experiences of individual in Construction Industry	39

## **LIST OF SYMBOLS**

AHP	Analytical Hierarchy Process
MOF	Garis Panduan Penilaian Tender (Kementerian Kewangan Malaysia)
CIDB	Construction Industry Development Board
W	Weighted
CI	Consistency Index
RI	Random Index
CR	Consistency Ratio
GMM	Geometric Mean Method

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

In the midst of the globalization era we can see that the construction sector is very important to meeting the current modernization of Malaysia. Where the construction sector is one of the most important factors contributing to the country's economic growth of infrastructure, building and becoming a developed nation. Standing strong skyscrapers, high-rise buildings in Malaysia can be concluded that Malaysia is on track to make the country a developed nation in southeastern Asia and is respected. The increase in contribution to buildings will lead the growth of investment in our country but behind the successful and complete project depends on parties that involved managing, controlling the flow and management of project in adequate manner with respective specification. This matter is evidenced by the statistics of the gross production rate released by The Office of Chief Statistician Malaysia Department of Statistics, Malaysia on 10 July 2017 this year. The compound annual growth rates stated that the gross output in construction sector has grown from 14.3 per cents to rm177.9 billion in 2015 as compared to rm91.3 billion in 2010.

For the performance of the construction sector through statistics on Economic Census of Construction Sector conducted in 2016 for reference year 2015 state that a total of 40,558 establishments were involved in this census with compound annual growth rate of 12.9 per cents as compared to 22,140 establishments of 2010. The positive growth is recorded for the overall performance of the construction sector in 2015 that give a good impact on economic Malaysia.

From the performance that are stated above can we conclude that from civil engineering sector, the need to manage information systematically, efficiently are very

important because competition now very high. As recommended by the minister of work, Dato' Seri Samy Vellu said:

“Whether we like it or not, we have to go global. Going global is a necessity and not a choice anymore if we want our construction industry to grow in the next millennium. “

Cost, time, quality and safety are the main element in construction where the contractors need to take it as the important thing during delivery the project given. So, the best example of choosing a contractor is that they concerned with the elements mentioned during the construction. Failure to select a competent contractor properly can lead to problems for the entire project. Selecting the best criteria for contractors by Multi-criteria decision making (MCDM) techniques where used Analytical Hierarchy Process (AHP) method. AHP allows decision to be constructed as hierarchies and each criterion can be assigned to a preference scale that is determined by the decision makers. AHP is a form that comparisons are made by priority-ranking model which the success factors identified in sequential manner, criteria with the highest score is deemed the best.

In Malaysia, this kind of ranking model is important because without a suitable and precise method in selection of contractors, it will affect the completion of project. It becomes quite popular for using AHP-based approach due to its simple and systematic implementations steps. Whatever the selection method is, the significance of three criteria which is time, cost and quality should be considered.

## 1.2 Problem Statement

The decline in the construction industry occurred around 2005 to 2006 with a rate of negative 5.1%. There was a reduction in the number of projects and many bankrupts' contractors (*CIDB News, 2005*). In Malaysia, issues faced for selection of contractor where they do not emphasizing an important aspect in the delivery of construction projects where it linked to project success, in term of time schedule, cost, and quality. Besides, the overall project quality and owner satisfaction is relevant to the contractor performing the work. Contractor need to understand the procedures for obtaining government, private projects or tenders. Many of them are blacklisted because they cannot afford financial risk and responsibility given to complete the projects, also demand in price from chosen contractors when come from closed tender.

From observation, it is found that the contractors with insufficient financing where most of them do not have sufficient capital to finance their undertakings. Then, lack of experience and skills in technical or through management in construction phase which contractor unable to complete the project given according to agreed costs and time scheduled. Also, their quality performance for previous project that give them positive or negative impact. However, this study will identify the best criteria or factors that are important during selection of contractors using Analytical Hierarchy Process (AHP) where a theory of measurement through pair wise comparisons and relies on the judgments of experts to derive priority scales was applied.



## REFERENCES

- Aczel J, Saaty TL (1983) Procedures for synthesizing ratio judgements. *J Math Psychol* 27:93-102.
- Ahmed, S.M. and R. Kangari, 1995. Analysis of client-satisfaction factors in construction industry. *J. Manage. Eng.*, 11(2):36-44.
- Alhazmi, T., & McCaffer, R. (2000). Project procurement system selection model. *Journal of Construction Engineering and Management*, 126, 176-184.
- Almeida, M.V. Pre-Qualification Of Contractors For High-Rise Building Projects In Philippines: A Selection Method In Construction Management Using Analytical Hierarchy Process (AHP) As A Tool In Decision Making. DLSU Research Congress 2016.
- Almeida, M. V. A Selection Method In Construction Project Management Using Analytic Network Process (ANP) As A Tool In Decision. DLSU Research Congress 2017.
- Balubaid, M. and Alamoudi, R. Application of the Analytical Hierarchy Process (AHP) to Multi-Criteria Analysis for Contractor Selection. *American Journal of Industrial and Business Management*, 2015,5, 581-589.
- Brunnelli, M. (2015). *Introduction to the Analytic Hierarchy Process*. Springer.
- Buku Keperluan dan Prosedur Pendaftaran Kontraktor. (2014). Lembaga Pembangunan Industri Pembinaan, 7-12.
- Cheung, S., Wong, P., Fung, A., & Coffey, W. (2006). Predicting project performance through neural networks. *International Journal of Project Management*, 24(3), 207-215.

- Dobi, K., Gugic, J. and Kancijan, D. (2010) AHP as a Decision Support Tool in the Multicriteria Evalution of Bids in Public Procurement. The 32nd International Conference on Information Technology Interfaces (ITI 2010), 21-24 June 2010, Catvat/Dubrovnik, 447-452.
- Drucker, P. F., (2001). The effective decision. The Harvard Business Review. Boston, MA:Harvard Business School Publishing Corporation.
- Fong, P.S. and Choi, S.K. (2000) Final Contractor Selection Using the Analytical Hierarchy Process. Construction Management and Economics, 18, 547-557.
- Forman EH, peniwati K (1998) Aggregating individual judgments and priorities with the analytic hierarchy process. Eur J Oper Res 108:165-169.
- Garis Panduan Penilaian Tender MOF, (2008). Bahagian Perolehan Kerajaan KEMENTERIAN KEWANGAN MALAYSIA.
- Hatush, Z., & Skitmore, M (1998). Contractor selection using multi criteria utility theory: An additive model. Building and Environment, 33(2-3), 105-115.
- Hatush, Z. and M. Skitmore, 1997. Assessment and evaluation of contractor data against client goals using PERT approach. Construct.Manage.Econ.,15:327-340.
- Holt, G. D., P.O. Olomolaiye and F.C. Harris, 1995. Contractor selection using multi criteria utility theory: an additive model. J. Build. Environ., 30: 553-561.
- Ibbs, W. and Y-Y. Chih. Alternative methods for choosing an appropriate project delivery system (PDS). Facilities 2011; 29(13): 527-541.
- Ishizaka, A., & Nemery, P. (2013). Multi-criteria decision analysis: Methods and software. West Sussex, UK: John Wiley and Sons.

- Jaselskis E.J. and Russell J.S. (1992). Risk analysis approach to selection of contractor evaluation method. *Journal of Construction Engineering and Management*, 118(4), 814-821.
- J. Alonso, M. Lamata. Consistency in the analytic hierarchy process: a new approach, *International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems* 2006; 445-459.
- Kumaraswamy, M., Anvuur, A., (2008). Selecting sustainable teams for PP projects, *Building and Environment*, 43(6), 999-1009.
- Malaysia, L.P. (2016). Keperluan dan Prosedur Pendaftaran Kontraktor dengan CIDB. 5-34.
- Maloney; W. (2002). Construction Product/Service and Customer Satisfaction. *Journal of Construction Engineering and Management*, 128(6), 522-529.
- Meghalkumar, I. Zala. And Prof. Ranjiv, B. Bhatt., An approach of contractor selection by analytic hierarchy process: multi criteria decision making system. *National Conference on Recent Trends in Engineering & Technology* 13-14 May 2011., 1-6.
- Nahmens, I., & Ikuma, L. H. (2009). An Empirical Examination of the Relationship between Lean Construction and safety in the Industrialized Housing industry. *Lean Construction Journal*, 1, pp.1-12.
- Nizamuddin, Zainuddin., Dayang Shalbia, Abdul Ghani., and Adam, Mohd Saifudin. Analytic Hierarchy Process(AHP) in Multi Criteria Decision Making: A case of Locating The Operations of Low Cost Carrier in Malaysia. *World Academy of Science, Engineering and Technology* 72 2012., 638-650.

- Palaneeswaran, E. and M. Kumaraswamy, 2001. Recent advances and proposed improvements in contractor prequalification methodologies. *Build. Environ.*, 36: 73-87.
- Pooyan, M.R. A model for Selecting Project Delivery System in Post-Conflict Construction Projects. *Building Civil and Environmental Engineering* 2012; 1-247.
- Portal Rasmi Lembaga Pembangunan Industri Pembinaan Malaysia (CIDB), (2017).
- Saaty, T.L. (1978) Exploring the Interface between Hierarchies, Multiple Objectives and the Fuzzy Sets. *Fuzzy Sets and Systems*, 1, 57-68.
- Saaty, T.L., "The Analytical Hierarchy Process", McGrawHill, New York, 1980.
- Saaty, T.L. Decision making with the analytic hierarchy process. *International Journal of Services Sciences* 2008; 1(1): 83-98.
- Saaty, T.L. (1994) How To Make a Decision: The Analytical Hierarchy Process, 24(6), Palaneeswaran 19-43.
- Saaty, T.L., 2001. Decision making in complex environments: the analytic network process for decision making with dependence and feedback. RWS Publications, USA., G. Ang et al.
- Saaty, T.L. (1987), The Analytic Hierarchy Process: Planning, Priority Setting, Resources Allocation, Rws Publication, Pittsburg, PA.
- Saaty, T. L. (2012). Decision Making for Leaders: The Analytic Hierarchy Process for Decisions in a Complex World. Third Revised Edition. Pittsburgh: RWS Publications.

- Saaty TL (1989) Group Decision making and the AHP. In: Golden BL, Wasil EA, Harker PT (eds) The analytic hierarchy process---applications and studies. Springer, Berlin, pp 59-67.
- Simon, H. A. (2003). Decision making: rational, non-rational, and irrational Educational Administration Quarterly, Vol. 29, pp. 392-411.
- Skitmore, M., 1999. Client and Consultant Perspectives of Prequalification Criteria. Term in Construction Management.
- Taylor, B. W. (2004). Introduction to management science. New Jersey; Pearson Prentice Hall Publishing.
- Thomas L. Saaty. How to make a decision: The Analytical Hierarchy Process. European Journal of Operational Research 48;(1990) 9-26.
- Topcu, Y.I., 2004. A decision model proposal for construction contractor selection in Turkey Building Environ., 39: 469-481.
- Tomashevskii IL (2015) Eigenvector ranking method as a measuring tool: Formulas for errors. Eur J Oper Res 240:774-780.
- T. Saaty and M. Ozdemir, How Many Judges Should There Be in a Group, Annals of Data Science 2014; 359-368.
- Utusan Online (2017). Pemilihan kontraktor. Kumpulan Utusan Malaysia.
- Zaini, A.A., Adnan, H., & Haron, R.C. (2010). Contractors' Approaches to Risk Management at the Construction Phase in Malaysia. Universiti Teknologi MARA: Master's Thesis.